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FOREST SERVICE—Circular No. 40.
GIFFORD PINCHOT, Forester.

THE UTILIZATION OF TUPELO.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., June 12, 1906.

SIR: I have the honor to transmit herewith a manuscript entitled "The Utilization of Tupelo," by H. B. Holroyd, Forest Assistant, Forest Service, and to recommend its publication as Circular 40 of the Forest Service.

The four text figures accompanying the manuscript are necessary for its proper illustration.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE UTILIZATION OF TUPELO.

TUPELO A WOOD OF VALUE.

It is only very recently that it has been possible to market tupelo under other than a fictitious name, so great has been the prejudice against this and other gums. Formerly, when lands bearing tupelo and cypress were logged, the cypress was taken and tupelo trees from 2 to 3 feet in diameter were left. This was because the lumberman considered tupelo worthless. The quality and usefulness of the wood were greatly underestimated, and the difficulty of handling it was magnified. Poor success in seasoning was laid to defects of the wood itself, when, as a matter of fact, the failures were largely due to the absence of proper methods of handling. The passing of this prejudice against tupelo is due to a better understanding of the characteristics and uses of the wood. Handled in the way which its particular character demands tupelo is a wood of value.

RANGE AND DISTRIBUTION.

The botanical range of tupelo extends along the Atlantic Coastal Plain from southern Virginia to northern Florida, through the Gulf States to the Nueces River in Texas, and northward through Arkansas, western Tennessee and Kentucky, and southern Missouri, to the lower Wabash River in Illinois. The species invariably grows in the wetter situations, often in swamps covered during the rainy season by from 2 to 20 feet of water.

At present tupelo is extensively milled only in the territory tributary to Mobile, Ala., and in southern and central Louisiana, the regions where it occurs in largest merchantable quantity. The stand of tupelo in the Mobile territory is estimated by mill owners to be 200,000,000 board feet. In Louisiana the stand is estimated to be nearly 4,000,000,000 board feet. From data obtained by the Forest Service it is safe to say that the total cut of tupelo in the United States in 1905 was about 40,000,000 board feet.

PROPERTIES OF THE WOOD.

The best grades of tupelo closely resemble yellow poplar. The wood is of medium weight, about 32 pounds per cubic foot when dry, or nearly that of red gum and loblolly pine. The shipping weight of the rough dry lumber is from 3,000 to 3,500 pounds per 1,000 board feet, or the same as that of cypress.

The wood has a fine, uniform texture, is moderately hard and strong, is stiff, not elastic, very tough and hard to split, but easy to work with tools. Tupelo takes glue, paint, or varnish well, and absorbs very little of the material. In this respect it is equal to yellow poplar and superior to cottonwood. The wood is not durable in contact with the ground, and requires much care in seasoning.

USES OF THE WOOD.

Tupelo is now used extensively for house flooring and inside finishing, such as moldings, door jambs, and casings. A good deal of tupelo lumber finds a market in European countries, where it is highly valued for different classes of manufacture. Of these countries England furnishes the best market and the greatest demand for square timber. There is also a good demand in England for the clear and upper grades of interior finish and flooring.

Much tupelo, especially of the lower grades, is used in the manufacture of boxes, since the wood works well upon rotary veneer machines. There is also an increasing demand for tupelo for laths, wooden pumps, violin and organ sounding boards, coffin manufacture, mantel work, conduits, and novelties. It is also used in the furniture trade for backing, drawers, and panels.

In the mill yards tupelo has almost entirely replaced cypress and pine for use in tramways. The latter woods will sliver up and wear out in a few years from the heavy traffic of the lumber trucks and roughshod mules, but tupelo laid for eight years shows no sign of decay and very little wear. The appearance of the wood when used for tramways indicates that it will make excellent flooring for depots, warehouses, and other places subjected to heavy traffic. Tupelo has also replaced cypress for sill work in the lumber trucks which are used on the tramways and which carry loads of lumber weighing from 6,000 to 7,000 pounds.

The large amount of sapwood found in tupelo indicates that it will take preservatives well. In this event it may find a use for cross-ties, street paving, and cross-arms.

MARKET CONDITIONS.

Owing to the prejudice against tupelo lumber, it was until recently marketed under such names as bay poplar, swamp poplar, nyssa, cotton gum, Circassian walnut, and hazel pine. Since it has become evident that the properties of the wood fit it for many uses, the demand for tupelo has largely increased and it is now taking rank with other standard woods under its rightful name. The Southern Cypress Manufacturers' Association adopted rules for the classification and inspection of tupelo lumber March 1, 1906, under which the standard

grades are: Box boards, first and second clear, No. 1 common, No. 2 common, and No. 3 common.

The average prices of the rough lumber delivered on a freight rate of 23 cents per 100 pounds were quoted by the Lumber Trade Journal, New Orleans, on July 1, 1906, as follows:

Price list on bay poplar (tupelo)—rough.

Box boards, 13 inches and wider	12 to 16 feet	$40.00
First and second clear—		
7 inches and wider	10 to 20 feet	30.00
1 inch by 4 inches	10 to 20 feet	30.00
1 inch by 6 inches	10 to 20 feet	31.00
No. 1 common—		
7 inches and wider	10 to 20 feet	24.00
1 inch by 6 inches	10 to 20 feet	26.00
No. 2 common	10 to 20 feet	20.00
1 inch by 4 inches	10 to 20 feet	22.00
No. 3 common	10 to 20 feet	18.00

LOGGING AND MILLING.

The advantage to the millman who can log tupelo, if only at a small profit, is obvious. Tupelo, in mixture with cypress, often forms from 50 to 60 per cent of the stand. If, therefore, the tupelo is taken with the cypress instead of being left on the ground, it will reduce the cost of logging the cypress and, in some cases, the cost of manufacture at the mill as well. This is especially true in the case of numerous lumber companies which purchased all the stumpage rights of a tract, and as payment was made on the basis of the cypress alone, the tupelo cost them nothing.

There are several methods of logging cypress and tupelo, depending upon local conditions. If the land is not too swampy and has a firm foundation, a logging railroad can be maintained and the cars loaded by means of steam skidders. Where the land is very low and subject to inundation a pull boat is generally used, and the logs are transported to the mill by towboats. For small operations the trees may be deadened and the logs afterwards transported to the mill by rafting during high water, but this method is not a sure one, and much loss is occasioned by the rotting of the logs. A combination of these methods is sometimes followed, if occasion demands.

All of these methods of logging are expensive, and the size of the cypress necessitates very heavy equipment for carrying on the operations. On the tracts where the tupelo runs small, the logging of it with heavy machinery designed for cypress reduces the profit realized from the manufactured product. In some mills where the shingle machinery is extensive enough to handle a continual run of cypress, the cutting of tupelo allows the shingle machines to stand idle. This

also applies to the lath machines, but as most of the manufacturers find a good market for tupelo lath, this difficulty is of minor importance.

AIR-DRYING.

WRONG METHODS.

The manufacturers of cypress lumber, who had been accustomed to pile it by cross-stripping with the same lumber—that is, "cross-stripping it on itself"—at first used this method for piling tupelo also. But

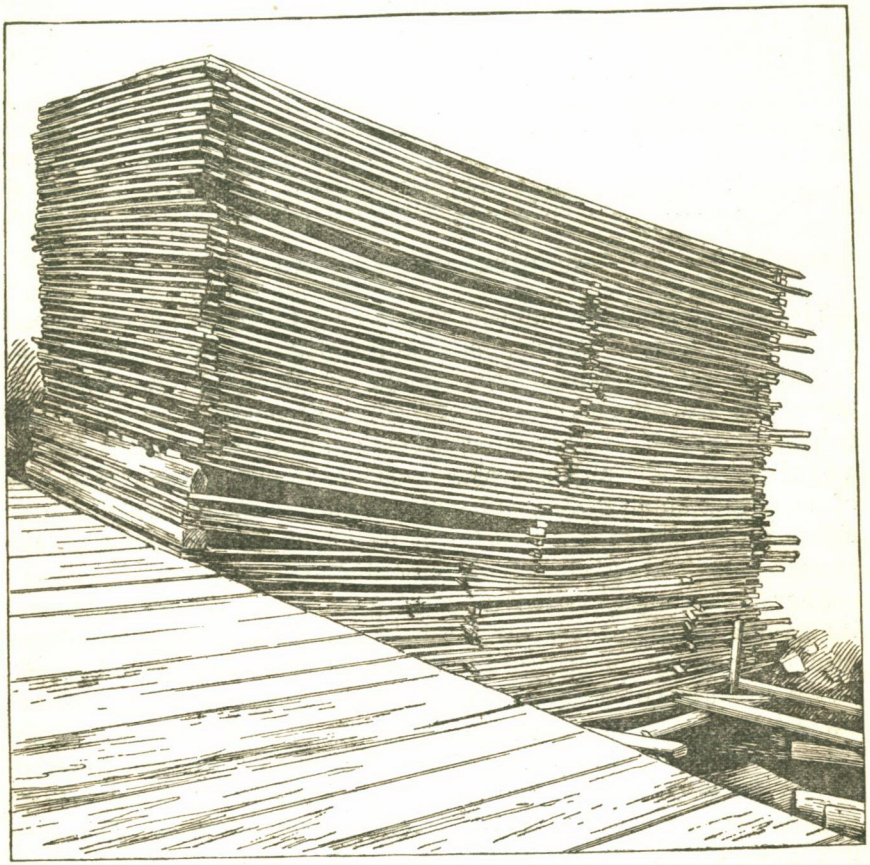

FIG. 1.—A bad method of piling tupelo. The cross strips are of irregular size, too few in number, and poorly placed. (Drawn from photograph loaned by the Lumber Trade Journal, New Orleans, La.)

while it is satisfactory for cypress it proved entirely unsuited for the other wood. Green tupelo boards from 6 to 8 inches wide were used for cross-stripping, but, where this was done, sufficient circulation of air to dry the boards where they crossed could not be secured. The lumber, in consequence, decayed rapidly, and much of it was reduced in grade from firsts and seconds to common.

Often the lumber was also very irregularly piled, and any convenient waste, such as edgings with the wane on, or short strips, was used for cross sticks. Where a strip reached only part way across the pile, another strip, which might be from half an inch to an inch thicker than the adjoining one, would be used. The use of strips of varying thickness in the same course caused the piles to become unwieldy and twisted. When the piles assumed this form an attempt to correct the error would be made by putting in an extra strip on top of the first

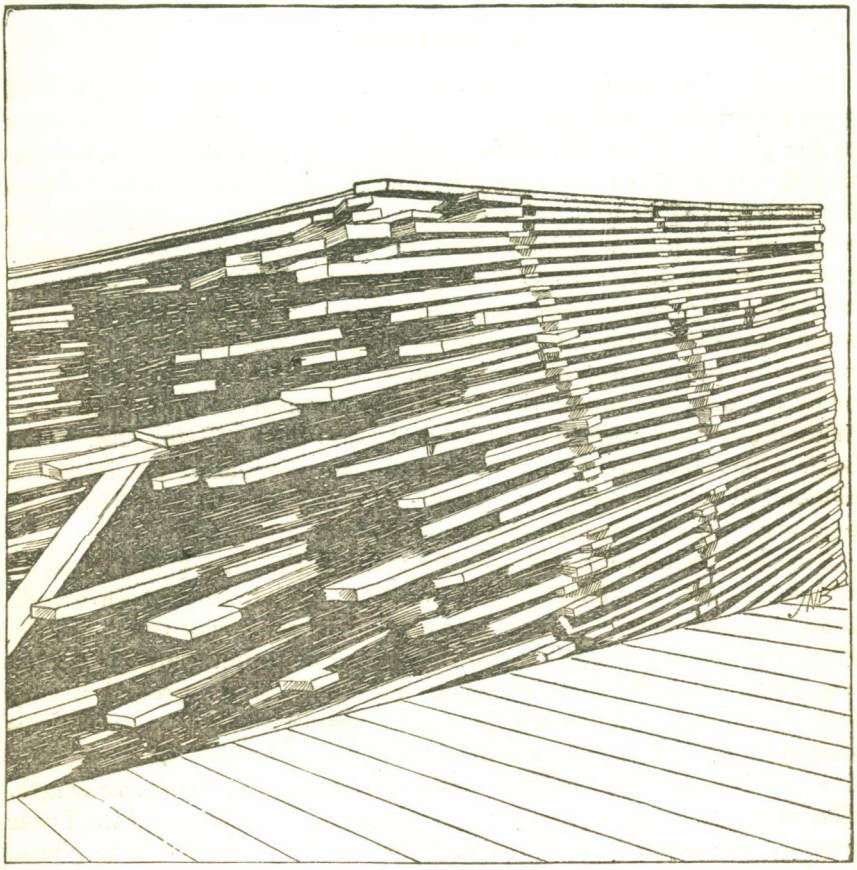

FIG. 2.—Another bad method of piling tupelo. Boards of different lengths piled together. Cross strips of irregular size and poorly placed. (Drawn from photograph loaned by the Lumber Trade Journal, New Orleans, La.)

one. In many cases the strips were not placed in a perpendicular line—that is, each one directly over the one in the next lower course. The result (see fig. 1) was similar to that obtained by holding one end of a board in a vise and applying a weight at the other end. Again, careless pilers would run the strips perpendicularly for some distance, and then discontinue this course and begin another a foot or two to the side of the original one (see fig. 1). In other cases the foundations were

insecure and one corner of the pile would sag, thus causing a diagonal twisting of the whole pile. The piles were made high and wide, and different lengths were put in the same pile, which increased the natural tendency of the wood to warp and twist (see fig. 2). Owing to their lack of success in piling tupelo, the manufacturers have experimented in various ways, using cross strips in greater number and of uniform size, smaller piles, and firmer foundations, and exercising more care in piling. The trade journals have also been instrumental in introducing better methods.

RIGHT METHODS.

To season tupelo successfully, the piles must be built carefully with good foundations and plenty of sticks. The foundation at the front of the pile should be at least 2½ feet high, and each succeeding foundation should be lower, in order that the pile may have a slope of 1 inch for each foot of length. According to this plan, the back foundation of an 18-foot pile would be 1 foot high. There should be as many foundations as there are series of cross strips. The foundations may be made of pecky cypress planks or squared tupelo timbers. The foundations are formed by simply placing one 3 by 18 or 3 by 24-inch piece of cypress on top of another until the desired height is obtained, or by building the tupelo timbers up in open crib fashion. The latter method ties the foundations together so that they will not slip, which is an advantage, but is more expensive on account of the increased amount of timber required. Some material may be saved by using narrower timbers for each successive course.

The best results are obtained by making the piles 6 feet in width and not over 16 or 17 feet high. If strips 1 inch in thickness are used, these dimensions will give about one hundred courses of 1-inch boards. Higher piles than these increase the danger of toppling over, or, if on wet ground, of the foundations giving way. If the ground is very wet, the piles should be made correspondingly lower. The cross strips should be from 1¼ to 2 inches in width and 1 inch thick, of thoroughly dry material, and preferably dressed to uniform size the entire length. The strips may be ripped from 12-foot cypress boards of the lower grades, and sawed again in the middle. Each strip should be placed in the pile exactly above the next lower one, to form a perpendicular course. There should be 7 strips to an 18-foot pile, 6 strips to a 16-foot pile, 5 strips to a 14-foot pile, and 4 strips to a 12-foot pile. The boards in each case should be laid 2½ to 3 inches apart. The piles should be roofed in such a way as to exclude the rain and at the same time admit plenty of air. There should be about 6 inches of space between the top course and the roof, and the latter should be extended a foot or two beyond each end of the pile. There should be at least 18 inches of clear space between piles.

A 14-foot pile with five foundations and five series of cross strips is shown in figure 3. This pile contains a "chimney," that is, an open space through the center of the pile, with a width equal to that of three boards for half the distance to the top and a width equal to that of one board for the rest of the distance. This method of piling secures an increased circulation of air, and may well be used with wide piles; but properly made narrow piles without chimneys give satisfactory results.

In actual practice the piling of lumber is much more difficult than it seems. One of the chief difficulties in the South is to secure careful

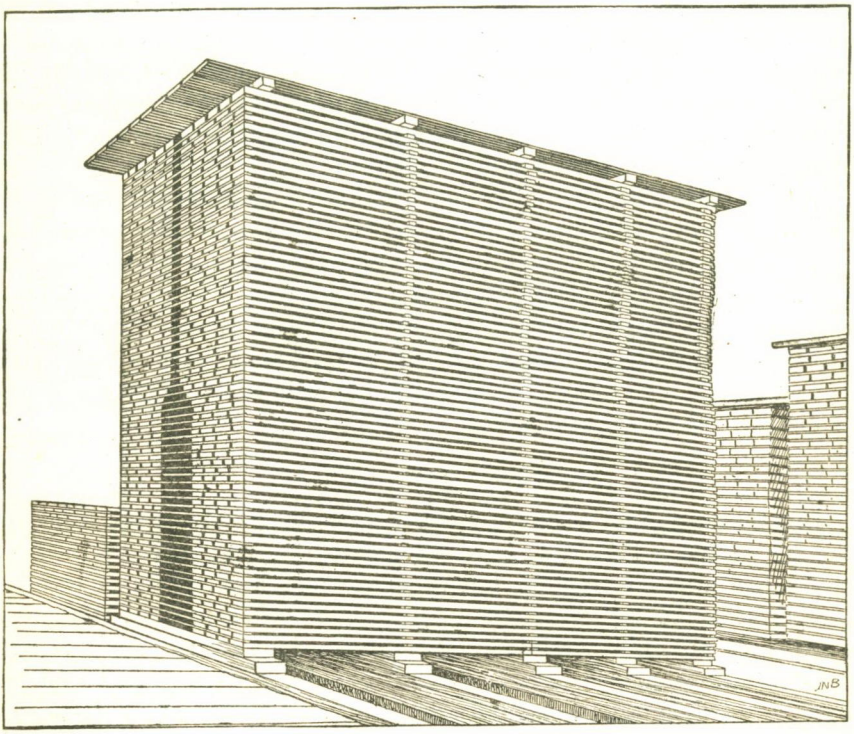

FIG. 3.—A well-built pile of tupelo, with a 5-section foundation and five series of cross strips.

labor. The narrower the piles are made the more difficulty there is in turning the boards on the jacks. The larger the number of cross strips used, the greater the cost of piling, because more time is required to handle the strips in order to keep them perpendicular in the course. If the boards are not placed rightly in the first laying, careless labor will slide them to place to avoid lifting, which will dislocate the cross strips and cause them to run up in a zigzag course. To avoid this the outside boards on each of the piles should be laid first, so that they will hold the strips in place. Careful pilers will keep constant watch

to see that the strips are kept in perpendicular line on each side. With good labor this additional care will take little extra time, but with poor labor it may serve as a welcome excuse for slow work. There is also an increased expense in the larger number of foundations required.

The leading manufacturers now realize that by using proper methods tupelo can be air-dried without staining or warping, and are handling it with the care and system which the value of the wood demands.

KILN-DRYING.

Few attempts have so far been made to kiln-dry tupelo, and these have usually been unsuccessful. A few manufacturers have run a truck load of tupelo through their kilns with cypress, and the results obtained point to the necessity for a different method of operation. The cypress manufacturers, sure of a market for their cypress and with their kilns running at full capacity, have hitherto had little inducement to experiment with tupelo.

In cooperation with a lumber manufacturer in Louisiana and a wagon manufacturer in Michigan, the Forest Service has recently completed an important and highly successful experiment in kiln-drying tupelo. The lumber was cut in Louisiana and immediately shipped to Michigan, where it was put through the kiln without preliminary seasoning. The lumber consisted of boards 1 inch thick, 8 to 12 inches wide, and 14 feet long. The lumber remained in the kiln fifteen days and came out in almost perfect condition.

DESCRIPTION OF KILN.

The kiln used in this experiment was one of a bank of six kilns in the dry house. The kilns, which take up the first story of the dry house, are all 50 feet long, but vary in width sufficiently to receive lumber from 12 to 18 feet in length. They are separated from one another by air-tight partitions and ceilings. The second story is not divided into compartments, but forms one large room, which can be used for storing dry or partially dry material. The hot air from the fan, which is situated in the engine room, adjacent to the dry house, is forced through an underground cement duct leading to the dry ends of the several kilns. As the hot air reaches each kiln, it comes up through three vents in the floor, which can be opened or closed at will. Thus the heat may be shut off from any one kiln when it is not in use.

The hot air rising through these vents at the dry end of the kiln passes back through the trucks of lumber to the wet end, and thence upward through a vent in the ceiling to the open room above. After circulating through this room it passes back to the engine room through an opening in the wall and over the steam coils to the fan, whence it returns to the kiln.

The kiln used is of the blower type, operated on the moist-air principle of drying. There is no communication with the outside atmosphere, since the dry house is made as nearly air-tight as possible; consequently the same air is used over and over again, and the necessary moisture is obtained from the green lumber in the wet end of the kiln.

TEMPERATURE AND HUMIDITY.

The lumber should enter a temperature of about 93° F. at the wet end of the kiln. The temperature gradually increases as the truck moves toward the dry end, where it should stand in a temperature of from 140° F. to 150° F. for two or three days. In this experiment the average temperature of the wet end of the kiln for the entire period of fifteen days was 98° F. and of the dry end 133° F.

The relative humidity at the wet end of the kiln when the lumber was first put in was 84 per cent and at the dry end 29 per cent. The lumber should be put in as green as possible, so that the evaporation from it will give the required moisture to the atmosphere.

PILING.

In stacking lumber on a kiln truck it should be so piled that the spaces between the boards are not obstructed by adjacent courses, but remain open, so as to give an upward vent and aid the circulation. This can be accomplished by piling the wide boards separately from the narrow ones, or by laying the wide boards so that they do not cover the open spaces. The old method of piling wide and narrow boards so as to obtain a horizontal circulation, both along and across the boards, is satisfactory in the open air, where there are strong winds, but in a kiln, where there is a space of only 2 or 3 inches on each side of the pile and only about 4 or 6 inches above and below, another method is needed to secure circulation. For this reason the lumber should be piled on the truck as openly as economical operation will permit. In this experiment the cross strips on one truck were placed 12 inches apart, and the end strips allowed to project slightly beyond the ends of the boards, as shown in figure 4. Equally good results were obtained with another truck, on which the cross strips were placed 18 inches apart.

RESULTS.

The lumber remained in the kiln for fifteen days, and when taken out was found to be dried satisfactorily without molding, staining, or stick rotting. Only one board was checked as far as 1 foot from the end; none of the other boards showed checks at the ends over half an inch in length, while most of them were not checked at all. Five boards on the top course were slightly warped.

The following table shows the weight of one truck load of lumber before and after drying, and also the amount of shrinkage due to

drying. There was a loss of 4,200 pounds, or about one-third of the green weight, and a shrinkage of 127.2 board feet, or 4.4 per cent of the original scale.

Weight of lumber and shrinkage due to drying.

Weight of lumber.		Loss in weight.		Scale.		Shrinkage.	
Green.	Dry.			Green.	Dry.		
Lbs. 12,900	*Lbs.* 8,700	*Lbs.* 4,200	*Per cent.* 32.6	*Bd. ft.* 2,876	*Bd. ft.* 2,749	*Bd. ft.* 127	*Per cent.* 4.4

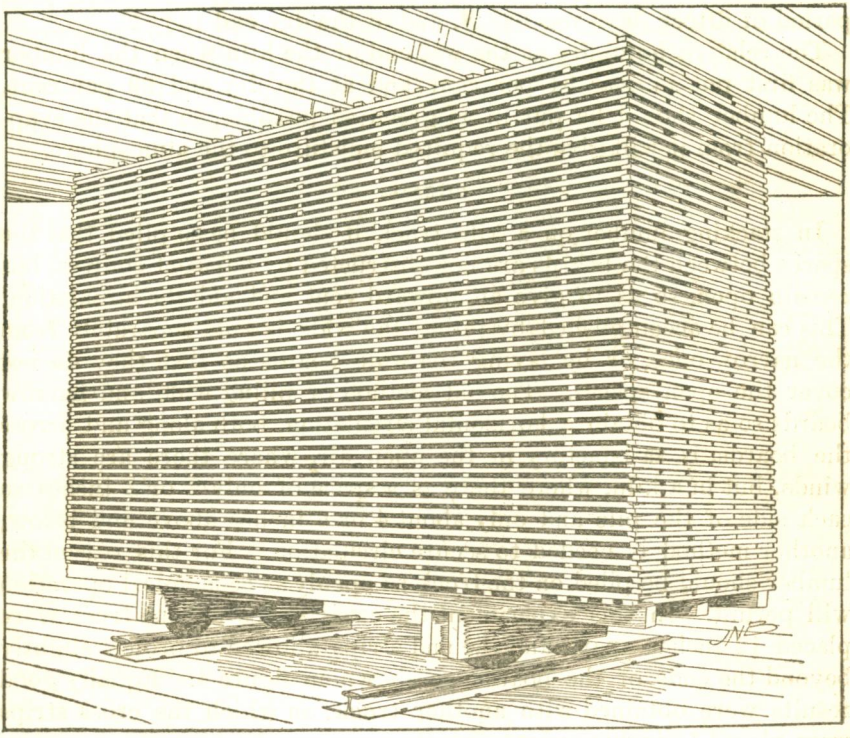

FIG. 4.—Truck-load of tupelo after being kiln-dried.

The method here described is that regularly used at this kiln in the drying of red gum, which occupied the other trucks at the same time. Thus it was shown that tupelo can be kiln-dried by the same methods that are used for the red gum, and with equal success.

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